

What is claimed is:

1. An electric discharge machining apparatus comprising:
  - a tool electrode having a tip end thereof directed to a work piece with a voltage being applied between said tool electrode and said work piece to generate a discharge;
  - a drive shaft connected with said tool electrode;
  - an electrode driving device having magnetic bearings for moving said drive shaft in three directions including a Z-axis direction that is an axial direction of said drive shaft, a Y-axis direction that perpendicularly crosses said Z-axis direction, and an X-axis direction that perpendicularly crosses said Y-axis direction and said Z-axis direction, by supplying electric current to electromagnetic portions of said magnetic bearings to control magnetic attractions thereof;
  - a movable coupling connected with an end of said drive shaft and being movable in said three directions; and
  - an electric motor connected with an end of said coupling for driving said drive shaft to rotate through said coupling.
2. The electric discharge machining apparatus as set forth in claim 1, wherein said coupling comprises: a Z direction slider connected with said electric motor disposed above said drive shaft and being movable in said Z-axis direction; a Y direction slider being movable in said Y-axis direction; an X direction slider being movable in said X-axis direction; and a spring disposed between said Z direction slider and said X direction slider or between said Z direction slider and said Y direction slider for urging said X direction slider and said Y direction slider toward said electric motor.
3. The electric discharge machining apparatus as set forth in claim 1, wherein said coupling comprises a universal joint.
4. The electric discharge machining apparatus as set forth in claim 1, further comprising a transportation unit mounted on said electric motor for moving said electric motor in said three directions.
5. An electric discharge machining apparatus comprising:
  - a tool electrode having a tip end thereof directed to a work piece with a

voltage being applied between said tool electrode and said work piece to generate a discharge;

a drive shaft connected with said tool electrode;

an electrode driving device having magnetic bearings for moving said drive shaft at least in a Z-axis direction among three directions including said Z-axis direction that is an axial direction of said drive shaft, a Y-axis direction that perpendicularly crosses said Z-axis direction, and an X-axis direction that perpendicularly crosses said Y-axis direction and said Z-axis direction, by supplying electric current to electromagnetic portions of said magnetic bearings to control magnetic attractions thereof; and

an electric motor for driving said drive shaft to rotate through a rotation transmission mechanism connected with said drive shaft.

6. The electric discharge machining apparatus as set forth in claim 1, further comprising a rotation detection unit mounted on said electric motor for detecting rotation information of said drive shaft, wherein the rotation of said drive shaft is controlled by a signal from said rotation detection unit.

7. An electric discharge machining apparatus comprising:

a tool electrode having a tip end thereof directed to a work piece with a voltage being applied between said tool electrode and said work piece to generate a discharge;

a drive shaft connected with said tool electrode;

an electrode driving device having magnetic bearings for moving said drive shaft at least in a Z-axis direction among three directions including said Z-axis direction that is an axial direction of said drive shaft, a Y-axis direction that perpendicularly crosses said Z-axis direction, and an X-axis direction that perpendicularly crosses said Y-axis direction and said Z-axis direction, by supplying electric current to electromagnetic portions of said magnetic bearings to control magnetic attractions thereof;

a plurality of bladed fixedly secured to said drive shaft; and

a rotation driving conduit having a tip end directed to said blades for guiding fluid to the neighborhood of said blades thereby to spray said fluid on said blades so as to rotate said drive shaft.

8. The electric discharge machining apparatus as set forth in claim 7, further comprising a cooling conduit mounted on said electromagnetic portions and having a tip end thereof directed to said electromagnetic portions for guiding said fluid so as to cool said electromagnetic portions.

9. The electric discharge machining apparatus as set forth in claim 8, further comprising a fluid cooling system for cooling said fluid.